ACCESSION #: 9607030158

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Beaver Valley Power Station Unit 1 PAGE: 1 OF 5

DOCKET NUMBER: 05000334

TITLE: Reactor Trip During Solid state Protection System Turbine

Testing

EVENT DATE: 05/31/96 LER #: 96-008-00 REPORT DATE: 07/01/96

OTHER FACILITIES INVOLVED: N/A DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: T.P. Noonan, Vice President Nuclear

Operations and Plant Manager TELEPHONE: (412) 393-7622

COMPONENT FAILURE DESCRIPTION:

CAUSE: B SYSTEM: SJ COMPONENT: RV MANUFACTURER: L265

B EL 83 A611

B SB PCV C635

REPORTABLE NPRDS: Y

Y

Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 31, 1996, Unit 1 reactor tripped due to an inadvertent turbine trip signal generated during solid state protection system testing. Both reactor trip breakers opened and all control rods fully inserted. All auxiliary feedwater pumps automatically started as designed on low-low steam generator water level. The 1B first point feedwater heater relief valve opened and did not immediately reclose due to a combination of setpoint drift and internal debris. The B train Emergency Diesel Generator automatically started, but was not required to load, in response to a momentary undervoltage condition on the B train emergency bus. Both emergency busses remained energized at all times. Post-trip review showed that the Anticipated Transient Without Scram Mitigating System Actuation Circuitry (AMSAC) did not function as expected due to a design deficiency, and the main generator trip and automatic fast bus transfer actuated early due to a timer setpoint drift. At the time of the occurrence, Unit 1 was in

Mode 1, operating at 100 percent power.

A comprehensive investigation has shown that the most likely cause of this trip was a test circuit that was applying more test current than the amount actually required to test this solenoid coil. Corrective actions include performing a modification which will reduce the test current for this circuit to the lowest practical value.

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PLANT AND SYSTEM IDENTIFICATION

Westinghouse - Pressurized Water Reactor

Solid State Control System/Turbine Trip Solenoid {JG/SOL}*_/

Emergency Onsite Power Supply System/Diesel Generator {EK/DG}

Anticipated Transient Without Scram Mitigating System Actuation Circuitry

{JG/-}

Main Generator Trip and Automatic Fast Bus Transfer Relay {EL/83}

Feedwater Heater Tube Side Relief Valve {SJ/RV}

Condenser Steam Dump Air Operator {SB/PCV}

*_/Energy Industry Identification System (EIIS) codes and component

function identifier codes appear in the text as {SS/CCC}.

IDENTIFICATION OF OCCURRENCE

Event Date: May 31, 1996

Date Determined to be Reportable: May 31, 1996

CONDITIONS PRIOR TO OCCURRENCE

Unit 1: Mode 1, 100% Reactor Power

There were no structures, components, or systems that were inoperable at the start of the event that contributed to the event.

DESCRIPTION OF EVENT

On May 31, 1996, Unit 1 was in Mode 1, with reactor power at 100%. The Nuclear Control Operator (NCO) was in the process of testing the turbine trip circuit portion of the B Solid State Protection System {JG/SOL} in accordance with Operation Surveillance Test 1.1.12. The NCO first energized a blocking relay, which is designed to inhibit the generation of an actual trip signal. He then verified that this relay had energized

by observing white lights deenergize on the panel. At 2114 hours, when the turbine trip was tested, the emergency trip solenoid (20 ET) operated. This caused a turbine trip and subsequent reactor trip. Both reactor trip breakers opened and all control rods fully inserted. All auxiliary feedwater pumps automatically started as designed on low-low steam generator water level. As a result of the rise in feedwater system pressure, the 1B first point feedwater heater relief valve {SJ/RV} opened. It did not reseat when pressure dropped (J E Lonergan Co, Model Number LOT-11). No other primary or secondary relief valves operated, and the condenser remained available as a heat sink. Two condenser steam dump valves did not operate properly. PCV-MS-106B and TCV-MS-106B4 (Copes-Vulcan, Inc. Model No. D100-160-3) did not indicate open on the control panel. Both emergency busses remained energized at all times. The B train Emergency Diesel Generator {EK/DG} automatically started, but was not required to load, in response to a

momentary undervoltage condition on the B train emergency bus.

DESCRIPTION OF EVENT (continued)

Operators immediately entered Emergency Operating Procedure E-0, Reactor trip or Safety Injection. The operators transitioned to procedure ES-0.

1, Reactor Trip Response, at 2118 hours to stabilize the unit in Hot Standby (Operational Mode 3).

A review of data after the event indicated that the Anticipated Transient Without Scram Mitigating System Actuation Circuitry (AMSAC) {JG/-} did not actuate as expected due to main feedwater flow fluctuation. The actuation initiation timer reset and reinitiated about 10 times. This actuation block was not expected, and has not been seen in previous post trip reviews.

The post trip review also revealed that the main generator trip and automatic fast bus Transfer occurred in approximately 28.9 seconds, below

the 30 1 second allowable range due to setpoint drift of the 62-AST relay (Automatic Timing and Control, Model Number 305E008L10PX).

CAUSE OF EVENT:

Based on the results of an extensive and comprehensive investigation, the most likely cause of the turbine trip was a higher than necessary test current combined with a lower than expected minimum current value necessary to energize the solenoid. The solenoid valve was changed during the last refueling outage, and testing revealed that it would operate at a lower current value than expected. There is no evidence of human or procedural error, test circuit or equipment malfunction.

The cause of the B train emergency diesel generator autostart has been determined to be an Engineered Safety Features actuation system undervoltage (start diesel) trip setpoint very close to the actual bus voltage value expected during fast-bus-transfer and reactor coolant pump starts. Engineering calculations show that an emergency diesel generator

autostart may be expected during a fast-bus-transfer.

The failure of AMSAC to actuate as expected following the trip was due to a problem in system design. The original design called for any single AMSAC input that failed (either high or low) to inhibit system initiation by deenergizing the actuation timer. During this particular trip, main feedwater flow signals wavered around zero. This fluctuation was sensed by the AMSAC circuitry as a failed channel, and caused the actuation timer to be reset numerous times.

The relief valve on the tube side of the 1B first point feedwater heater lifted due to its setpoint having drifted low. The as-found setpoint was 1440 psig, while its specified setpoint is 1600 psig. The valve did not reseat due to an accumulation of fine rust that was found caked in the disk and nozzle.

ANALYSIS:

This analyzes the results of the investigation and evaluation performed following the reactor trip. A separate analysis is provided for the failure of the AMSAC to function as designed.

Human factors, including human performance and procedural quality, were not found be a factor. A critique held by Operations immediately after the event determined that the procedure was followed verbatim. The procedure performer was not having problems with the procedure or test panel and there were no distractions. The procedure had been performed many times before without problems. A technical review of the procedure confirmed that the procedure steps were correct and were in the correct order.

A technical investigation conducted at the safeguards test cabinet shortly after the trip revealed no evidence of any equipment malfunction in the test circuit. Voltages and currents for each step of the test circuit were obtained. The current limiting resistors were found to be

the correct value. The test switch, blocking relay and test lights all operated properly. All electrical abnormalities, such as grounds, were inspected for and none were found. The procedure was deliberately performed out of order to simulate a performance error, but no sequence resulted in a turbine trip.

The only area of investigation that seemed possibly unusual and thus warranting further investigation was the voltage and current values measured at the solenoid during the test. The purpose of the solenoid test is to verify coil continuity by allowing a low value of current to flow through the solenoid. A low value of current is used in order to prevent actually tripping the turbine. The post trip values seemed higher than necessary to test the solenoid. This investigative avenue was pursued, and three factors were discovered that have an impact. The first factor noted was the change in solenoid operated valve (SOV) manufacturer from Parker-Hannifin's to Sterling which took place in 1993.

It is believed that Sterling SON's will actuate at lower current values than the previously installed Parker-Hannifin's. Secondly, the SOV that caused the turbine trip was just recently replaced and had been in service less than a month. Westinghouse documentation states the SOVs need the least current to operate when they are new, requiring progressively more as they age. Finally, during the physical inspection conducted as part of the investigation, personnel discovered test lights installed in parallel with each of the solenoid coils. Testing showed that the test light has a dramatic effect on the test current through the solenoid coil. The light both eliminated the inrush current normally seen, and reduced the current flowing through the solenoid. When the light was discovered on this coil, it was either burned out or not making contact. Whenever this occurred, testing showed that solenoid current would have increased, placing the solenoid test current much closer to the value where the SOV would have actuated and tripped the turbine.

Taken together, these three factors (a new type of solenoid valve, a brand new solenoid valve, and a test bulb which was no longer reducing the test current) explained how a turbine trip was probable at this time, when there had never been one before.

The AMSAC did not actuate as expected following the trip. AMSAC is designed to protect the reactor from a loss of heat sink. Although not part of Technical Specifications, it was required to be installed per 10 CFR 50.36. AMSAC is designed to actuate when 2 of 3 main feedwater channels (one per loop) are less than 25% and when 2 of.2 turbine impulse pressure channels are greater than 40 %. This coincidence results in a turbine trip signal and auxiliary feedwater pump start. To prevent spurious actuation, AMSAC output is automatically defeated upon a loss of an input. Per the original design, a feedwater flow channel input signal is bad when loop current is less than 3.68 ma. Because one feedwater flow channel was in fact wavering around the out of range setpoint during

a portion of the event, the AMSAC timer was reset each time a feedwater flow channel input loop current dropped below the 3.68 ma setpoint. This was unexpected and had not seen in previous post trip reviews.

CORRECTIVE ACTIONS:

1. A modification has been approved (TER 10446) for the turbine trip test circuitry. This modification will: remove the test lights which are installed in parallel with each of the Sterling solenoid operated valves on the turbine pedestal trip block; change resistors in each of the Sterling solenoid operated valve test circuits to reduce the test current to the lowest practical value for this circuit. This will be completed prior to the next performance of surveillance test OST-1.1.12.

2. An evaluation to determine the feasibility of revising the existing Technical Specification setpoint for the Unit 1 emergency diesel

generator undervoltage start to be the same value specified for Unit

2 has been initiated. This will be completed by August 31, 1996.

3. An INPO NUCLEAR NETWORK Operating Plant Experience Report concerning

the potential failure of the AMSAC to actuate when required was

issued.

4. The Units 1 and 2 AMSAC systems were modified to correct the design

actuation problem. The Unit 1 AMSAC system was returned to service

on June 8, 1996. The Unit 2 AMSAC system was similarly modified,

and was subsequently returned to service on June 12, 1996.

5. The train A main generator trip and automatic fast bus transfer

relay 62-AST was recalibrated.

6. The 1B first point feedwater heater tube side safety valve RV-SV-11B

setpoint was adjusted and retested satisfactorily.

REPORTABILITY:

This event is reportable in accordance with 10 CFR 50.73 (a) (2) (iv), any event that resulted in an automatic actuation of an Engineered Safety Feature, including the Reactor Protection System.

SAFETY IMPLICATION:

There were minimal safety implications as a result of this event. The reactor protection system actuated as designed to properly shutdown the reactor and stabilize the unit in Hot Standby. Engineered Safety Feature systems actuated as required upon receipt of initiation signals.

This event is bounded by Updated Final Safety Analysis Report section 14.1.7, Loss of External Electrical Load and/or Turbine Trip.

Based on the above, the health and safety of the public were not affected.

SIMILAR EVENTS:

There have been no previous similar events at Beaver Valley Unit 1 or 2 involving a reactor trip due to emergency trip solenoid testing.

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Nuclear Group

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June 28, 1996

NPD1VPO:0493

Beaver Valley Power Station, Unit No. 1

Docket No. 50-334, Licensee No. DPR-66

LER-96-008-00

United States Nuclear Regulatory Commission

Document Control Desk

Washington, DC 20555

In accordance with Appendix A, Beaver Valley Technical

Specifications, the following Licensee Event Report is submitted:

LER 96-008-00, 10 CFR 50.73.a.2.iv, "Reactor Trip During Solid State

Protection System Turbine Testing."

T. P. Noonan

Division Vice President

Nuclear Operations/Plant Manager

JH/jcd

Attachment

The Nuclear Professionals

June 28, 1996

NPD1VPO:0493

cc: Mr. T. T. Martin, Regional Administrator

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